Defying Gravity

A small Swiss firm develops an innovative G suit for fighter pilots

Col. Hank Morrow, commander of the 149th Fighter Wing of the Texas Air N flying for more than two decades. In that time, he has seen aircraft push the hi planes today are so fast and nimble that standard evasive maneuvers can add t gravity, or nine g's, to the mass of a pilot's body. That amount of force causes death as gravity drives blood and oxygen from the brain, lungs and heart. G s pilots by filling with compressed air and squeezing the lower extremities to s Yet G-suit technology has stagnated for almost half a century, while rapid inn have put many pilots at the mercy of their machines. All that can change if t its aviators with a revolutionary liquid-filled G suit called the Libelle.

The suit is the brainchild of Andreas Reinhard, a former Swiss Air Force flight founder of Life Support Systems, a company he launched in 1996 to develop air, the Libelle forms a liquid barrier around the pilot, much like a baby is pro recently tested the suit at Edwards Air Force Base in California and was so ec told the members of the Libelle team he would write them a personal check or him one.

Reinhard says he first got the idea for the Libelle--the German word for "drag was still in the Swiss Air Force. He was inspired by the dragonfly because it i withstand 30 g's of force, because its cardiac system is encased in liquid. "Aft session, I was extremely exhausted," he recalls. "I imagined filling the whole the same viscosity and density of blood."

In crafting the Libelle, Reinhard revived a concept developed in the 1940s, wl appeared. The first suit was developed in Canada by Wilbur Franks of the Uni found that when he suspended glass test tubes in water, they didn't break in th observation to a crude prototype suit by sandwiching a layer of water between devised a workable suit with air bladders; his basic design is more or less ider use.

In seeking to improve today's suits, one of the first challenges for Reinhard an liquid that could absorb g forces but that was nontoxic and nonflammable. Af suits, including one filled with silicone ("like what's in breast implants," Reinl on distilled water spiked with a secret "special material" that prevents the Lib pilot eject at high altitudes. The liquid--housed in two-inch-wide channels tha legs and torso--is harmless enough to drink, even serving as an emergency rat Reinhard says.

Another task was finding a fabric that could dynamically respond to sudden cl to cover the whole body with a material that wouldn't stretch under pressure," same time, the suit had to be flexible so the pilots could move." After unsuc mills, the Libelle's engineers decided to make their own material. They devise Du Pont's flame-resistant Nomex fabric with tough Kevlar aramid fibers, that axis but flexible vertically."

As g forces intensify during a hypersonic turn or downward spiral, the Libelle pulling with them the surrounding fabric. Imagine a self-contain hydrostatic progressively squeezes the pilot as he hits the afterburner. A conventional G s

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respond, because air must be pumped into various bladders from the plane's o
"With the Libelle, you didn't feel it working," says Lt. Col. Christian Ledet, a
the Iowa Air National Guard who also tested the suit at Edwards. "It was just
the laws of physics, doing its job before you even knew it."

The Libelle suit is the first of its kind to reach production and has proved a w
advanced air-filled suits, such as the U.S. Air Force's Combat Edge system. D
Edwards, one pilot wore the Libelle, while another, seated in the rear cockpit,
"We went up to 18,000 feet, hit the afterburner and started 9-g spirals until the
uncle," Morrow remembers. "It was easier to breathe and easier to communi-
confirms. "When I came back, I didn't feel like a wrung-out wet rag. With a re
out of the cockpit."

Two years after starting the Swiss-based Life Support Systems, Reinhard fom
Autoflug, a German producer of aircraft rescue and safety equipment, to help
and marketing of the Libelle. Besides the U.S. tests, a number of test pilots in
air forces have flown in the suit, trials that proved a success. The company's a
Britain, Germany, Italy and Spain to put the Libelle on the Eurofighter, a next
four countries are building to eventually replace the Mig-29, the Phantom and

In October the U.S. Department of Defense chose the Libelle for its foreign co
program. Reinhard contends that "the Pentagon process is too slow." But in th
off: the yearlong evaluation will begin this spring. Assuming it passes with hi,
be recommended for an air force-wide buy," says Maj. John Ryan, program m
office. There are no guarantees, but air force procurement of the Libelle wou
Autoplug and the Libelle's private investors a bundle of cash.

Although first-round trials at Edwards and in Europe were promising, Ulf Bal
Wyle Laboratories unit in Houston, Tex., and president of the International A
Space Medicine, feels that medical evidence establishing the Libelle's outrigh
have been working with G suits for many years, and as far as I'm concerned it
proven properly," he says. But Reinhard does not agree: "After a few hundred
hundreds of test flights with more than 80 different subjects, we believe we ar

Any doubts about the Libelle should be sorted out by the rigorous FCT progr
and engineers will poke and prod the suit to ensure that it is the best technolo
after sortie to see where the suit has merit, where it's better and where it's not.
Demitry, chief of the U.S. Air Combat Command's Human Systems Integrato

In the meantime, Reinhard and teams at Life Support Systems and Autoflug a
design to satisfy the demanding specs mandated by potential customers (U.S.
while continuing to make their pitch to the Eurofighter contingent. As for a w
Reinhard and company will have to wait until at least 2003. But if the exalted
any measure, it's hard to believe that the Libelle won't come out on top.